Dose Measurement and Control

WINdose for Excel
2002

Installation & Operations Manual

100-153 082305

REQUIREMENTS

WINdose for Excel 2002 is designed in a Microsoft Excel™ platform. *WINdose for Excel* 2002 was developed and intended for use as a component of the GEX *WINdose Dosimetry System*. It was designed to provide communication between the Thermo Spectronic *Genesys 20* spectrophotometer and an IBM compatible PC with a Microsoft *Windows 2000* or high operating system and *Microsoft Excel 2000* or higher spreadsheet application program. The program contains communication files that are not compatible with older versions of these Microsoft Products.

DISCLAIMER and GENERAL PRECAUTIONS

The *WINdose for Excel* software program is intended for use in the preparation of standardized Dose Report forms that are printed, reviewed and authorized as documents by the end user. The software was not designed to provide database or information storage in any manner. The user is responsible for verification of the accuracy of the data contained in the reports generated using the *WINdose for Excel* software. Users are also responsible for determining the suitability and performance of the software for their specific applications.

GEX Corporation does not warrant the data input or output associated with this software. All dose results and any subsequent usage of the data derived from usage of this software are the sole responsibility of the user. Further, by acceptance, implementation and use, the user assumes any and all risks associated with such usage of this user manual and the associated software product.

WINdose for Excel workbooks communicate only with Genesys 20 spectrophotometers. The use of any other spectrophotometer requires that the software be used in the manual mode (see **Appendix A – Manual Mode Operation**). Custom communication software programs may be developed and validated separately based on a customer specific set of requirements.

The *WINdose for Excel* worksheets contain unlocked cells. These cells are unlocked in order to make certain formulas work properly. Users should have a working knowledge of basic Microsoft Windows™ and Microsoft Excel™ functions in order to use the worksheets effectively.

WINdose for Excel users assume complete responsibility for the application of the software product and agree to use the software program in accordance with the information and instructions contained in this user manual. The examples given in this manual are based on GEX recommended program uses; other uses of the program are possible. Contact GEX to discuss your specific application needs.

USER SPECIFIC WORKBOOKS

The WINdose for Excel 2002 installation CD places a demonstration calibration curve file on your computer in the WINdose for Excel 2002 folder inside the Program Files folder on the Hard Drive of the computer. This curve is for **demonstration and training purposes only**. Your **Calibration Specific Workbook(s)** specific to your facility and your dosimeter batch(es) must be installed separately. The dose calculation coefficients from your specific GEX dosimeter batch calibration are embedded into each **Calibration Specific Workbook** and are traceable to a specific “best fit” calibration curve. This information is hidden and locked and users should not attempt to access this information. Users should perform an initial verification of the dose formulae upon receipt of this program using absorbance values from the “Dose Estimate Table” in your Calibration Report (see GEX procedure template #100-255 for a recommended procedure for verifying the validity of the dose calculations in WINdose for Excel).

UNAUTHORIZED MODIFICATION OF *WINDOSE FOR EXCEL* WORKSHEETS CAN VOID THE VALIDATION.

WINdose for Excel 2002 Summary Validation Statement

The *WINdose for Excel* 2002 software program was developed using generally accepted industrial practices for software development design/control that included use of a formal Design Requirements document to guide the design and validation of the software product.

The completed software product was placed under version and change control and underwent formal verification and validation testing using a protocol that included hazards analysis testing to confirm that the product fulfilled its Design Requirements when used in accordance with the Installations and Operations Manual.

An Exception Log was maintained throughout the verification and validation testing to report software "exceptions" from the specifications and performance requirements. All Exception Log items were completed and closed and a revision level software version ID was designated to control future software changes.

The verification and validation testing demonstrated that the *WINdose for Excel* 2002 product meets is full design specifications and operational performance requirements when the software is used with the specified WINdose Dosimetry System components in accordance with the instructions provided in the *WINdose for Excel* Installation and Operations Manual and related procedures contained in the GEX #6100 Procedure Template Notebook. The verification and validation testing also determined that the master constants used in the software were appropriate for the requirements and intended functionality of the software product and provided verifiable results that are repeatable and reproducible.

The results of the hazards analysis testing provided several improvements to reduce or eliminate potential function errors or change through misuse, abuse or inadvertent user actions. In addition, several user information advisories and warnings were included that identify potential sources of non conformance conditions as a result of inappropriate or unauthorized user actions.

Users are instructed to perform an initial verification test of the dose formulae upon receipt of each **Calibration Specific Workbook** by using absorbance values from the "Dose Estimate Table" in the associated GEX furnished **Calibration Report** (see GEX procedure template #100-255 for a recommended procedure for verifying the validity of the dose calculations in *WINdose for Excel*). The estimated dose value obtained should match the dose estimate value in the "Dose Estimate Table" of the user's **Calibration Report** (within rounding differences of +/- 0.1 kGy).

Verification of the **dosimeter response** is accomplished by the calculation: $R = (Ai – Ao) / t$.

Where
$Ai = Absorbance_{irradiated}$ of the individual dosimeter
$Ao = Absorbance_{original}$, average for the batch
t = thickness, average for the batch

Security protection is applied to the critical dose calculation functions and calibration information is provided through GEX managed password controlled functions isolated from user access. These calibration identification and curve coefficients are contained in a hidden, password protected worksheet. This password is maintained by GEX Corporation and available for use only by trained GEX personnel.

The macros used to calculate doses and communicate with a spectrophotometer are password protected and maintained by GEX.

The hazards analysis testing resulted in a series of user information warnings related to potential damage

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to the *WINdose for Excel* workbooks by applying standard MS Excel functions that permit user freedom in overwriting cell data, modifying cell and worksheet formatting and deleting cells rows and columns.

The full *WINdose for Excel* software verification and validation testing and software development history package is available for customer review and audit at our Denver, Colorado USA facility during normal business hours. These records will be maintained by GEX for an indefinite period. Users may purchase a copy of this package, however, it is up to the user to request copies of change validations that may occur. Users may incur a cost for updates.

WINdose for Excel - Theory of Operation

The *WINdose for Excel* program was designed and developed as a major component of the WINdose Dosimetry System. The function of the *WINdose for Excel* software component is to provide the means of recording dosimeter absorbance measurements and preparing standardized dosimetry reports related to the dose measurements made for facility dose mapping, product dose mapping and routine process dose monitoring applications.

WINdose for Excel utilizes specialized computer code with embedded master constants derived from user specific dosimeter batch calibrations to estimate doses from user entered dosimeter absorbance values. The software program requires an IBM compatible computer with a Microsoft Windows operating platform and MS Excel with MS Visual Basic tools to operate.

Individual process run dosimetry worksheets are used in the customized MS Excel workbooks to provide a means of user data entry for specific GEX products. Users complete the preformatted worksheets, filling in colored space holders with appropriate data specific to the process run. Information includes the technician name, date, the product information and run identification number, process date(s), etc. Dosimeter specific information including batch ID and calibration ID, calibration coefficients, etc. are stored in the specific WINdose for Excel workbook itself. After the process information is entered, the measurement process begins.

The WINdose for Excel software uses MS Visual Basic code and custom macros embedded in an MS Excel workbook to transfer absorbance values directly from an integrated spectrophotometer (hand entry of the absorbance is also available). The *WINdose for Excel* 2002 software version was designed to work only with the Thermo Spectronic Genesys 20 model spectrophotometer using an RS232 bi-directional communication link. The Genesys 20 display shows the current dosimeter absorbance value that allows the operator visual verification of the data values as they are transferred into the computer software. The Genesys 20 is preset at the factory to default to the 554 nm wavelength of the B3 dosimeters at the conclusion of the automated instrument startup process.

Dosimeter ID#s are recorded by the operator along with their specific measurement locations. The software program accepts this data via direct input through the computer keyboard or through a keyboard wedge barcode reader. The B3 dosimeter packages are then opened, the dosimeters removed and transferred into the dosimeter holder, and into the readout compartment of the spectrophotometer.

A digital value of absorbance is displayed on the spectrophotometer. Once the readout value is stable and observed as reasonable, a computer keyboard command is used to instruct the software program to transfer the spectrophotometer value into the worksheet. The operator verifies that the value displayed on the instrument was correctly transferred and inserted into the worksheet. As each absorbance value is entered, an embedded formula automatically calculates the response value (net change in absorbance per dosimeter thickness) and the dose from your batch calibration curve coefficients.

A separate command can be used to calculate doses if absorbance values are manually entered. Applicable reference dose position ratios may be applied to calculate a Dmax and Dmin dose for the run.

The completed process run specific *WINdose for Excel* worksheets may then be printed, reviewed, authorized and archived.

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WINdose for Excel 2002 Quick Install

The enclosed CD contains the installation program for *WINdose for Excel* 2002. Turn off virus detector software before installing *WINdose for Excel* as some files required to establish communication with the spectrophotometer must be written directly into the Windows™ System folder. Virus detectors can be turned on again after the installation is complete.

WINdose for Excel 2002 must be installed on your computer's Hard Drive. Do not install the program over a network as it will not function.

Installation Using the CD:

1) Close all programs and insert the WINdose for Excel CD.

2) Open the CD and view contents.

3) Read and follow any README files that contain version specific information and additional instruction.

4) Double-click "setup". Setup will load the installation program and check your system setup.

5) Follow the installation instructions on-screen.

6) Depending on the existing software components in the computer system, Setup may require that the computer be restarted.

7) An Adobe Acrobat .PDF copy of the *WINdose for Excel* Manual is also found on the CD.

CAUTION: Setup installs a demonstration curve during the initial *WINdose for Excel* installation. This curve is not appropriate for use at your process facility if dose traceability is required. Contact GEX to obtain current industry recommendations related to performing a traceable calibration of specific dosimeter batches. After you have performed a traceable calibration, you will receive your calibration specific curve data file with the Calibration Report. This **Calibration Specific Workbook** file will need to be installed into the WINdose for Excel 2002 folder in the Program folder on the Hard Drive. You can remove the demo curve at time you install the **Calibration Specific Workbook** file.

Hardware Installation

Attach the RS-232 cable to the Genesys 20 spectrophotometer and to the COM1 port on the computer. The *WINdose for Excel* software is set to only recognize the COM1 port. Be sure this is set appropriately or the data input function will not work.

Every time a workbook is opened the program will check for a connection to a Genesys 20 spectrophotometer. If it cannot find one, a warning message indicating that the spectrophotometer function is disabled will appear after about 30 seconds. The *WINdose for Excel* software program can also be operated without the computer being connected to the spectrophotometer by manual entry of the absorbance values.

If used, attach the bar code reader (GEX# P4201) to the computer. Unplug the computer keyboard and plug it into the Y adapter supplied with the reader. Plug the Y adapter into the keyboard port on the computer. The bar code reader does not require any additional software installation.

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Installing your Calibration Specific Workbook

The demonstration curve installed automatically by the WINdose for Excel 2002 Installation program is for training and practice only. It needs to be replaced with your dosimeter batch **Calibration Specific Workbook** (a separate WINdose for Excel 2002 file containing batch specific calibration data supplied by GEX) before using WINdose for Excel 2002 at your facility to perform dosimeter batch specific measurements that are traceable to a national standard.

Please maintain a Master copy of the **Calibration Specific Workbook** (supplied with GEX Calibration Reports on CD-ROM) in a secured place.

INSTALLATION
Copy your **Calibration Specific Workbook(s)** file(s) to the directory C:\Program Files\WINdose for Excel 2002 on the computer. It is recommended that the "demo" (this file is an Excel file named WINdose for Excel 2002) curve workbook file be removed at this time. This completes the installation of the **Calibration Specific Workbook(s).** *WINdose for Excel* will require selection of the appropriate **Calibration Specific Workbook** file the next time the program is opened.

As an option, create a shortcut to the specific *WINdose for Excel* file. Use standard Windows™ methods to create the shortcut.

Instructions for Removing WINdose for Excel 2002 Demo file

Browse to the directory C:\Program Files\WINdose for Excel 2002. Highlight the "WINdose for Excel 2002" file as shown in the picture. Press the Delete key or drag it to the Recycle Bin.

Then click the Windows™ Start button and navigate to the WINdose for Excel 2002 shortcut.
Right click the shortcut and select Delete from the menu or change the path to a WINdose for Excel **Calibration Specific Workbook** file.

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Customizing Facility Information

UNAUTHORIZED MODIFICATION OF *WINDOSE FOR EXCEL* WORKSHEETS CAN VOID THE VALIDATION.

Contact GEX Corporation for information and requirements related to modification of any of the preformatted worksheets. GEX maintains formal change control over the *WINdose for Excel* software and will provide users with a controlled means of customizing the software to specific user needs in a controlled manner.

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Basic Operation

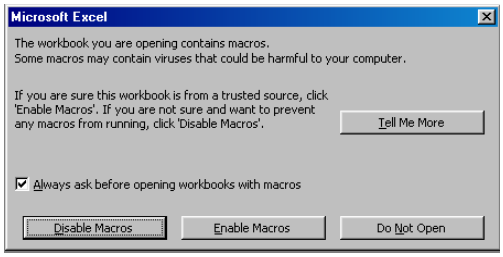
STARTING THE EQUIPMENT:
Start your computer before turning the Genesys 20 instrument on. The instrument may be turned off and on without rebooting your computer. It is good practice to turn the instrument off and on once per day, to allow it to run through its self checks. Perform the following:

- Remove the cuvette cup, turn on the instrument.
- Allow the instrument to warm up for at least thirty minutes
- Ensure that the instrument is set to 554 nm
- Ensure that the instrument is in the Absorbance mode
- Insert the cuvette cup
- Insert the sample holder (for GEX holders see the particular holder information sheet)
- Close the sample compartment lid and press the “0 ABS” button

NOTE - *The worksheet screens shown in this manual are samples only. Your screens may have a slightly different appearance depending on your computer setup.*

STARTING THE DEMONSTRATION PROGRAM:
Click the Windows™ Start button and go to Programs > WINdose for Excel Demo.

When opening the initial template, you may be asked if you wish to enable macros. Click on “Enable Macros” to open the workbook.


Microsoft Excel
The workbook you are opening contains macros.
Some macros may contain viruses that could be harmful to your computer.
If you are sure this workbook is from a trusted source, click 'Enable Macros'. If you are not sure and want to prevent any macros from running, click 'Disable Macros'.
Tell Me More
Always ask before opening workbooks with macros
Disable Macros
Enable Macros
Do Not Open

NOTE: *If your security is set to high in Microsoft Excel, the screen above may not appear. Use the Tools > Macros > Security drop down menus Excel to set your security to the medium or low level. At the low level, the above screen will not appear.*

The program will search for the spectrophotometer for up to 30 seconds. During this time, a message will appear on screen as shown below.

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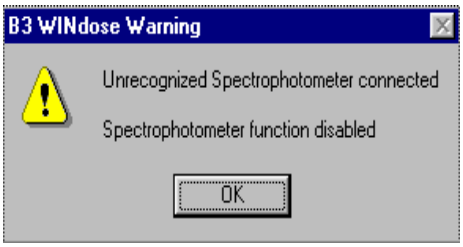
If the program cannot communicate with the spectrophotometer within 30 seconds, the following warning message will appear. Close the program and check the RS232 cable connections if a spectrophotometer is connected.



NOTE: This is a warning message, not an error message. It will appear every time the program is started without a Genesys 20 spectrophotometer. **You may use the program without the computer being connected to the Genesys 20 spectrophotometer, but there is up to a 30 second delay required by the software for the spectrophotometer search to complete.** See Appendix A called "Manual Mode Operation" for more information.

STARTING YOUR FACILITY-SPECIFIC PROGRAM:
Open your facility specific file. The same operations will occur as when opening the demo file detailed on the previous page.

The program will search for the spectrophotometer and the message from the previous page will appear. During this period the standard Excel™ edit menus at the top of the screen will turn gray and not be functional. Do not make any keyboard entries or mouse clicks during this period. If the program cannot communicate with the spectrophotometer within 30 seconds, the warning message will appear. As with the demonstration workbooks, you can still run the dose calculation macro but all absorbance reading information will have to be entered manually.

If you wish to save a dosimetry data file electronically, you should immediately use the "File > Save As…" function to assign a new name to the file and store the file in the appropriate file folder/directory. The integrity of a file in use can be maintained by making sure the file is marked "Read Only" in the file's 'Properties' and/or by saving the file as a Microsoft Excel template file.

GEX PRODUCT SPECIFIC WORKSHEETS IN THE WORKBOOK:
The batch **Calibration Specific Workbook** contains worksheets for the products that a customer uses. This setup is determined at the time of the dosimeter batch calibration. Custom worksheet modifications are available at any time by contacting GEX.

To begin using the software, simply open the **Calibration Specific Workbook** and select the appropriate dosimetry worksheet. There are several basic worksheets and, for electron beam users, several specialty worksheets. Worksheets that you do not use that were not removed by GEX from your **Calibration Specific Workbook** may also be deleted at any time using standard MS Excel conventions.

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STANDARD WORKSHEETS:

Routine Dosimeter Worksheets	Reading Method
B3000 - Dose Report	1 dosimeter replicate per dose point
B3002 - Dose Report	2 dosimeter replicates per dose point
B3004 - Dose Report	4 dosimeter replicates per dose point

The operation of these worksheets is discussed in the next section.

APPLICATION SPECIALTY WORKSHEETS:

Electron Beam Specialty	Testing Method
B3106 - X and Y Uniformity	Process uniformity measurement strips
B3110 – Energy Wedge Card	10MeV extrapolated range energy using RISØ wedge
B3112 – Energy Wedge Card	5MeV extrapolated range energy using RISØ wedge
B3200 – B3 Film Energy Stack	Extrapolated range energy measurement 100-300 keV range
B3202 – B3 Film Energy Stack	Extrapolated range energy measurement 50-120 keV range

The operation of these worksheets is covered in individual appendices titled by product worksheet (i.e.- B3106 Appendix).

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Using Standard WINdose for Excel Worksheets

PROCESSING INFORMATION ENTRIES:
The top fourteen rows of all worksheets are used to document product and process information. **Never delete any of rows or insert new rows before the first dosimeter row of a worksheet**. See the section in this manual titled "Customizing Facility Information" for details on worksheet modifications.

Make entries in the colored cells, all other cells are locked. As information is entered or values change, the cell turns white. The TAB key will move the cursor to all unlocked cells in the worksheets, the arrow keys can be used to move to any cell in the worksheets. The routine dosimetry screens appear like this:

5			DOSIMETRY REPORT				
6							
7		Customer:			Process Number:		
8		Product:			Process Specification:		
9		Lot(s):			Dmin/Ref Ratio:	Dmax/Ref Ratio:	
10		Quantity:			Min Dose Spec:	Max Dose Spec:	
11		Process Date:					
12		Technician:			Min Dose in Process:	Max Dose in Process:	
13		Dosimetry Date:					
14		Instrument:					
15	Correction Factor: 1.00			Wavelength: 554 nm		Average Thickness: 0.0183	
16	Dosimeter Batch: B3WINdose AA			Calibration Date: 11/17/01		Initial Average Absorbance: 0.040	
17	Calibration ID: GEX DEMO			Dose Range: 1.5 to 65 kGy		Software Version: 1.3	

See **Appendix B** of this manual for a detailed description of each field in the Dosimetry Report.

MEASURING DOSIMETERS: (Example is a B3000 Worksheet)
Enter a dosimeter identification number in the first shaded cell in row 20, column B. This may be done manually or through a bar code reader. Using the tab or arrow keys, move to the next cell to the right (column C) and enter a dosimeter position.

18			Dosimeter	Irradiated	Response			Adjusted
19		Dosimeter ID	Position	Absorbence (Ai)	(Ai - Ao) / t	Dose (kGy)		Dose (kGy)
20		1234567		0.000	0.000	na		

Type a position identifier, this may be a number or a word, and use the tab or arrow keys to move one cell to the right (column D).

18			Dosimeter	Irradiated	Response			Adjusted
19		Dosimeter ID	Position	Absorbence (Ai)	(Ai - Ao) / t	Dose (kGy)		Dose (kGy)
20		1234567	Reference	0.000	0.000	na		

Place a dosimeter in the spectrophotometer. When the value is stable, press these three keys simultaneously: **Ctrl+Shift+a**. The absorbance value measured by the spectrophotometer will be placed in the cell, the response value, doses calculated, and a new row inserted with the cursor placed in the Dosimeter ID column.

18			Dosimeter	Irradiated	Response			Adjusted
19		Dosimeter ID	Position	Absorbence (Ai)	(Ai - Ao) / t	Dose (kGy)		Dose (kGy)
20		1234567	Reference	0.250	11.475	14.8		14.8
21				0.000	0.000	na		

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The three standard worksheets vary by the number of replicate absorbance values the worksheet uses. Above you saw how to fill in the **B3000** worksheet.

In a **B3002** worksheet (two dosimeter replicates per package) use the **Ctrl+Shift+a** command to transfer the replicate A absorbance value (column D), and the cursor moves to the next column (E).

18			Dosimeter	Irradiated Absorb.		Response			Adjusted
19		Dosimeter ID	Position	A	B	(Ai - Ao) / t	Dose (kGy)		Dose (kGy)
20		1234567	Reference	0.250	0.000	4.645	na		

Then use **Ctrl+Shift+a** again for replicate B. From replicate B (column E) **Ctrl+Shift+a** inserts the absorbance value, calculates dose, and a new row is created with the cursor placed in the Dosimeter ID column, ready for a new dosimeter reading.

18			Dosimeter	Irradiated Absorb.		Response			Adjusted
19		Dosimeter ID	Position	A	B	(Ai - Ao) / t	Dose (kGy)		Dose (kGy)
20		1234567	Reference	0.250	0.252	11.530	14.9		14.9
21				0.000	0.000	0.000	na		

In a **B3004** worksheet (four dosimeter replicates per package), you will enter four absorbance values for each dosimeter packet using the **Ctrl+Shift+a** command. From replicate D, the **Ctrl+Shift+a** command will invoke the calculations and creation of a new row.

18			Dosimeter	Irradiated Absorbencies (Ai)				Response			Adjusted
19		Dosimeter ID	Position	A	B	C	D	(Ai - Ao) / t	Dose (kGy)		Dose (kGy)
20		1234567	Reference	0.250	0.251	0.252	0.250	11.516	14.8		14.8
21				0.000	0.000	0.000	0.000	0.000	na		

In each of the different standard worksheets, the dosimeter response is calculated automatically from the formula: ***Final absorbance*** less ***Original absorbance*** divided by ***Thickness*** **[(Ai–Ao) / t]**. The ***Original absorbance (Ao)*** and the ***Thickness (t)*** are listed in the "Calibration Information" (gray section) on the worksheets.

The "Dose (kGy)" is computed from the embedded curve coefficients. "Adjusted Dose", "Min Dose in Process" and "Max Dose in Process" are calculated as follows:

Adjusted Dose – Is the calculated **Dose (kGy)** multiplied by the **Correction Factor**.

Max Dose in Process – Calculates the maximum **Adjusted Dose** value for the process run multiplied by the **Dmax/Ref Ratio**.

Min Dose in Process – Calculates the minimum **Adjusted Dose** value for the process run multiplied by the **Dmin/Ref Ratio**.

NOTE: You must enter values into the **Dmin/Ref Ratio** and **Dmax/Ref Ratio** in order for maximum and minimum doses in process to calculate.

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TEMPERATURE MONITORING

If you are using the P8003 Temperature Indicators in a process run, the maximum temperature from the indicator can be typed into Column A under **P8003 Max Temp**. The "Max Temp in Process (°C)" will search the column for the highest temperature in the process report and display the value in cell H11.

10		Quantity:				Min Dose Spec:			Max
11		Process Date:			Max Temp in Process (°C):		32		
12		Technician:							
13		Dosimetry Date:				Min Dose in Process:			Max Dose
14		Instrument:							
15		Correction Factor:	1.00			Wavelength:	554 nm.		Average
16		Dosimeter Batch:	B3WINdose AA			Calibration Date:	11/17/01		Initial Average A
17		Calibration ID:	GEX DEMO			Dose Range:	1.5 to 65 kGy		
18	P8003		Dosimeter	Irradiated Absorb.		Response			Adjusted
19	Max Temp	Dosimeter ID	Position	A	B	(Ai - Ao) / t	Dose (kGy)		Dose (kGy)
20	45.0	1234567	Reference	0.250	0.250	11.475	14.8		14.8
21	32.0	1234569	Reference	0.148	0.148	5.902	6.9		6.9

RE-MEASURING A DOSIMETER

If it becomes necessary to re-read a dosimeter(s), save the file with a revision name. Place the dosimeter back into the spectrophotometer. Highlight the appropriate absorbance cell in the worksheet and **delete the old value**. Run the **Ctrl+Shift+a** command as normal; the program will not insert a new row unless you are on the last row that you had used. All doses on the worksheet will be recomputed. You can also place the cursor in the "calculated dose" column of the last row and re-compute doses by using the **Ctrl+Shift+d** command, which will re-compute doses for the entire worksheet.

MISSING or DAMAGED DOSIMETERS

WARNING: Should one dosimeter be damaged out of a group (i.e. – 1 replicate out of 2 for the B3002) the following steps MUST be followed to record an accurate measurement:

1) The software requires that a value be entered in the first absorbance column if there is more than one on a particular worksheet. Therefore, in the example of the B3002, even if Replicate A is damaged you must enter Replicate B in the first absorbance column in order for the program to calculate doses.
2) In the example above, you must delete the 0.000 from the Replicate B absorbance column so that the column is blank (null). The response calculates an average of the two absorbance columns in this case and it will count the 0.000 as a value and divide the sum of the two absorbances by 2 to get the average if you do not make the unused column null. See the examples below.

INCORRECT METHOD

18			Dosimeter	Irradiated Absorb.		Response			Adjusted
19		Dosimeter ID	Position	A	B	(Ai - Ao) / t	Dose (kGy)		Dose (kGy)
20		1234567	Reference	0.250	0.000	4.645	na		

CORRECT METHOD

18			Dosimeter	Irradiated Absorb.		Response			Adjusted
19		Dosimeter ID	Position	A	B	(Ai - Ao) / t	Dose (kGy)		Dose (kGy)
20		1234567	Reference	0.250		11.475	14.8		14.8

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OUT OF RANGE MESSAGES:
Occasionally doses will not compute and the "Dose (kGy)" column will look like this:

18			Dosimeter	Irradiated Absorb.		Response			Adjusted
19		Dosimeter ID	Position	A	B	(Ai - Ao) / t	Dose (kGy)		Dose (kGy)
20		1234567	Reference	0.041	0.043	0.109	Under Range		
21		1234568	Reference	0.980	0.980	51.366	Over Range		

These messages signify that the dosimeter response does not lie within the calibrated range of the dose response curve. In the example above, the top row is below the calibrated range, and the bottom row is above the calibrated range.

To arrange installation support and/or schedule an interactive training support session, contact GEX Corporation at 303-400-9640 or e-mail us at: sales@gexcorporation.com

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Appendix A - Manual Mode Operation

WINdose for Excel was designed for measuring *B3WINdose* dosimeters while connected to a Genesys 20 spectrophotometer. However, it is possible to operate it in manual mode only, **with certain precautions**. The worksheets do not contain detailed error-trapping and are intended to be used by qualified personnel under controlled conditions.

All worksheets in the workbook were designed to obtain values from the spectrophotometer when you press the three keys **Ctrl+Shift+a**, and to insert rows when appropriate. If you use the software for manual data entry, the only difference is how the **Ctrl+Shift+a** command is used.

When there is no spectrophotometer or communications have been lost, **Ctrl+Shift+a** will write a zero into the absorbance column cell and still insert a new row as it does when connected to a spectrophotometer.

If an absorbance value is manually entered using a keyboard, the **Ctrl+Shift+a** command is still used to calculate doses and create new rows. The difference is that the command must be executed from the "Response" column of the dosimeter you are working on. All other operations of the **Calibration Specific Workbook** remain the same.

STANDARD WORKSHEETS:

Follow these steps to use the **B3000**, **B3002** and **B3004** worksheets in the manual mode:

- Start with the first dosimeter measurement in row 20. Fill in the dosimeter number, position and the absorbance measurements using the keyboard.
- Using the arrow key, move the cursor to the Response column. Press **Ctrl+Shift+a**, and the doses will calculate and a new row will be created.

SPECIALTY WORKSHEETS:

The **Ctrl+Shift+a** will work the same in manual mode when executed from the "Response" column. New rows are not inserted on these worksheets when the command is executed.

You also have the option of using a different command on the worksheets to calculate doses in the manual mode. This involves reading all dosimeters, using the tab, arrow, or enter keys to move to the next absorbance, and once you have entered all measurements, use the **Ctrl+Shift+d** command (with the cursor on any dosimeter row in the worksheet) to calculate all the doses for dosimeters in the spreadsheet..

RE-READ MEASUREMENTS:
To re-read a dosimeter in manual mode, follow the description in the previous section for re-reading a dosimeter, with the following exception:

When the old absorbance value is deleted, enter the value manually and use the steps described above to calculate the doses depending on what kind of worksheet you are working on

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Appendix B – Dosimetry Report Fields

	A	B	C	D	E	F	G	H	I	J	K
5				**DOSIMETRY REPORT**							
6											
7			**Customer:** 1				**Process Number:**	9			
8			**Product:** 2				**Process Specification:**	10			
9			**Lot(s):** 3				**Dmin/Ref Ratio:**	11	**Dmax/Ref Ratio:**	12	
10			**Quantity:** 4				**Min Dose Spec:**	13	**Max Dose Spec:**	14	
11			**Process Date:** 5				**Max Temp in Process (°C):**	15			
12			**Technician:** 6								
13			**Dosimetry Date:** 7				**Min Dose in Process:**	16	**Max Dose in Process:**	17	
14			**Instrument:** 8								
15		**Correction Factor:** 1.00 18				**Wavelength (nm):** 554 21				**Average Thickness (t):** 0.0183 24	
16		**Dosimeter Batch:** B3WINdose AA 19				**Calibration Date:** 11/2/02 22			**Initial Average Absorbance (Ao):** 0.040 25		
17		**Calibration ID:** GEX DEMO 20				**Dose Range:** 5 to 65 kGy 23			**Software Version:** 1.3.1 26		
18	P8003		Dosimeter	Irradiated Absorb.		Response			Adjusted		
19	Max Temp	Dosimeter ID	Position	A	B	(Ai - Ao) / t	Dose (kGy)		Dose (kGy)		
20	27	28	29	0.000 30	0.000	31	32		33		
21											
22		**Prepared by:**			**Date:**						
23											
24		**Reviewed by:**			**Date:**						

1) **Customer** – Name of the customer whose product was processed.
2) **Product** – Identification of the product processed.
3) **Lot(s)** – Lot or lot numbers that were processed.
4) **Quantity** – Quantity of the product processed.
5) **Process Date** – Date the product was processed.
6) **Technician** – Name of the technician performing the dosimetry and filling out the report.
7) **Dosimetry Date** – Date the dosimetry for the process run was performed.
8) **Instrument** – The name and/or serial number of the spectrophotometer used in the dosimetry measurement.
9) **Process Number** – Identification number assigned to the specific process run.
10) **Process Specification** – Identifier of the **Process Specification** that defines the master processing specifications.
11) **Dmin/Ref Ratio** – The ratio of the reference monitoring position to the minimum dose position on the product (E-Beam) or carrier (Gamma) established during dose mapping.
12) **Dmax/Ref Ratio** – The ratio of the reference monitoring position to the maximum dose position on the product (E-Beam) or carrier (Gamma) established during dose mapping.
13) **Min Dose Spec –** The determined minimum dose the product must receive as specified in the Product Specification.
14) **Max Dose Spec –** The determined maximum dose the product can receive as specified in the Product Specification.

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15) **Max Temp in Process (°C) –** The maximum temperature that was observed in the process run as determined by finding the maximum temperature in the **P8003 Max Temp** column.
16) **Min Dose in Process –** The estimated minimum dose in process determined by taking the lowest **Adjusted Dose** in the process multiplied by the **Dmin/Ref Ratio** (from process specification).
17) **Max Dose in Process –** The estimated maximum dose in process determined by taking the highest **Adjusted Dose** in the process multiplied by the **Dmax/Ref Ratio** (from process specification).
18) **Correction Factor –** A linear correction used to adjust dose calculations based on calibration specific data (e.g. a correction of 0.10 can be used to convert from kGy to Mrad).
19) **Dosimeter Batch –** The dosimeter batch that was calibrated and that is valid for use with the **Calibration Specific Workbook** ID being displayed.
20) **Calibration ID –** The GEX assigned calibration ID for the specific "best fit" curve that the software is using to calculate doses.
21) **Wavelength –** The wavelength at which the spectrophotometer must be set to read dosimeters from the **Dosimeter Batch.**
22) **Calibration Date –** The date the dosimeter batch calibration was performed.
23) **Dose Range –** The range of doses that the calibration is certified for and thus the range within which the software can estimate doses.
24) **Average Thickness –** The average thickness of the dosimeter batch used for the calibration.
25) **Initial Average Absorbance –** The initial average background absorbance of the dosimeter batch used for the calibration.
26) **Software Version –** The version of the *WINdose for Excel* **Calibration Specific Workbook** being used.
27) **P8003 Max Temp –** An area to manually enter the maximum temp achieved on the P8003 Temperature Indicator if the indicator was attached to dosimeters for a process run.
28) **Dosimeter ID –** The individual identification number of the dosimeter.
29) **Dosimeter Position –** The position of the dosimeter during the process run (i.e. Reference Position, etc.).
30) **Irradiated Absorbance –** The absorbance value of the dosimeter as determined with the spectrophotometer
31) **Response (Ai – Ao) / t** – The calculated response of the dosimeter per the listed formula.
32) **Dose (kGy)** – The dose calculated by the software from a dosimeter **Response** value.
33) **Adjusted Dose –** The Dose (kGy) multiplied by the correction factor if one is used. Default setting is 1.00.

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B3106 Appendix

For automated reading of B3106 10 Inch Uniformity Measurement Strips

DESCRIPTION

The B3106 associated *WINdose for Excel* worksheet is used to read the optical absorbances of the sequentially numbered dosimeters. The embedded formulae and macros automatically calculate the response and dose estimates based on the current calibration coefficients in the worksheet. The results also update and display a uniformity graph of the dose results. These may be used for electron beam applications involving evaluation measurements of horizontal and perpendicular scan uniformity. The B3106 strip cards may be joined to form strips of continuous lengths or staggered/overlapped to increase the measurement interval resolution.

GENERAL INFORMATION

Dose uniformity techniques and requirements are described in both ASTM/ISO 51649 and ASTM /ISO 51818.

Users should have a working knowledge of basic Microsoft Excel™ functions and charts in order to use the worksheets and manipulate the charts effectively.

Some cells are unlocked to allow users to adjust them for their specific systems.

For detailed instructions on performing measurements using the B3106 Uniformity Strips, see GEX Procedure Template #100-261 in our S6100 Procedure Template Notebook (this can be downloaded from the GEX website as with all recommended procedures) or your company specific procedure if applicable.

Measuring the B3106 Uniformity Measurement Strip
Open *WINdose for Excel* and select the B3106 worksheet from the tabs at the bottom of the screen. Enter the processing information in the top section of the worksheet.

NOTE: The specialty worksheets may require modification of formulas from the preformatted state.

The dosimeters in each strip are provided in sequential order for user convenience. Enter the first dosimeter number into cell B20 and the worksheet will automatically fill in the next nine numbers.

If you are using more than one B3106 strip for one direction's length, simply enter the first dosimeter of the next strip after the last dosimeter of the previous strip. The worksheet comes preformatted for a total of 30 dosimeters but can be modified to span over 100 inches.

NOTE: When setting up a uniformity test with the B3106 product, be sure to note the positioning of the strip in the test configuration. If you run the strip in a different direction the numbering may not be appropriate for the manner in which the test was run.

If you are using fewer than 30 dosimeters you can delete the unused rows from the final report by highlighting the rows, right clicking on the mouse and selecting "delete" or by selecting the rows and clicking Edit > Delete.

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To add rows for longer arrays of strips, highlight the first 10 rows (20-29) and select copy using standard Windows methods. Highlight the row that you want to inert in front of, right-click, and select ”Insert Copied Cells”.

You will also need to change the “Distance” column in the worksheet to accommodate the new cells. Place the cursor in cell D49 and click and drag so that the “Distance” cells for the new rows are all highlighted and use the MS Excel fill down command **Ctrl+d** to fill in the cells with the extended distance numbers. When you are done the distances should contain a sequential continuation of the original 30 rows (i.e. 31, 32, 33, etc.)

If the test has smaller increments of distance because strips were overlapped, simply change the distance in the first cell (C20) to the actual distance in inches and cell C21 to increment the proper distance.

Measuring the Strips of Dosimeters
Measure the irradiated absorbances of each dosimeter on the strip from end to end as described in the Basic Operation section of this manual. For this type of worksheet, new rows are not added as in the basic dosimetry worksheets.

NOTE: It is easiest for manual mode users to enter all of the absorbance values and then use the **Ctrl+Shift+d** command to calculated doses.

Calculating the Uniformity
The worksheet automatically calculates the dose relative to the entrance dose in column J. The relative dose is calculated by dividing the measured dose by the average of the measured doses. The worksheet also automatically calculates the average dose, the standard deviation of the doses, and the coefficient of variance (CV) of this average. The CV is the expressed as a percent.

For some types of uniformity measurements, such as scan width/height, users may wish to select the flat a portion of the curve and eliminate the overscan tails for the uniformity measurement. The example below shows how this may be performed.

EXAMPLE:
The following is an example of a scan width/height test showing how the electron beam drops off at the end of the scan. Uniformity is tested over the area of greatest interest, in this situation the width of a product tote 20 inches wide. Dosimeters #1-#2 and #22 - # 30 were extended past the sides in order to demonstrate that the electron beam in fact overscanned the width of the product. The area of greatest interest therefore involves only dosimeters #3 through #21.

Average Dose formula cell (Cell F15):
This formula is preset to incorporate all 30 preformatted rows (H20 to H49). To modify, select cell F15 and click the mouse in the range (H20:H49) that is displayed in the Excel Formula Bar near the top of the screen. This highlights both ranges in the formula (**NOTE:** both ranges are the same). This also highlights the actual column of data with a colored border box. Resize the box to incorporate only those points which are of interest for the test. You will have to do this twice as there is one box for each range in the formula even though they are the same range. Hit the RETURN key when you have the proper range selected. For our example, we will select (H22 to H40).

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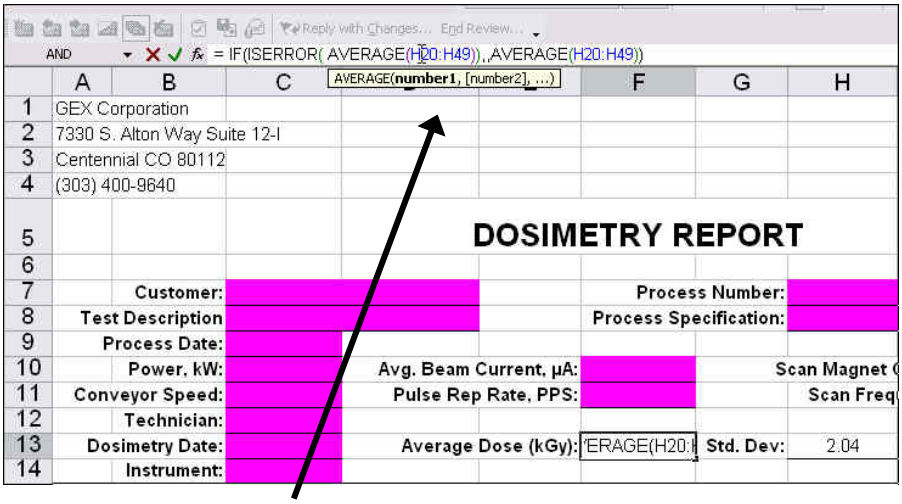
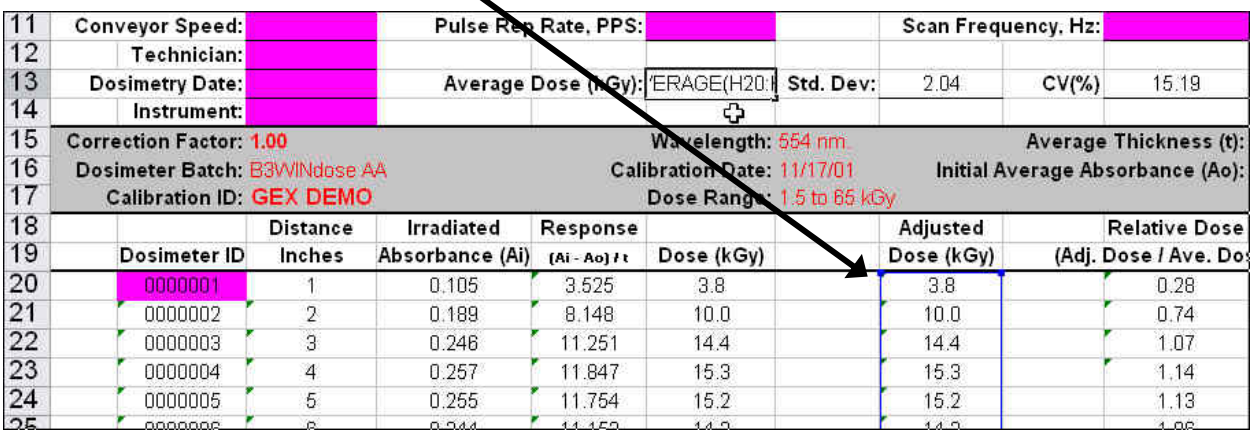
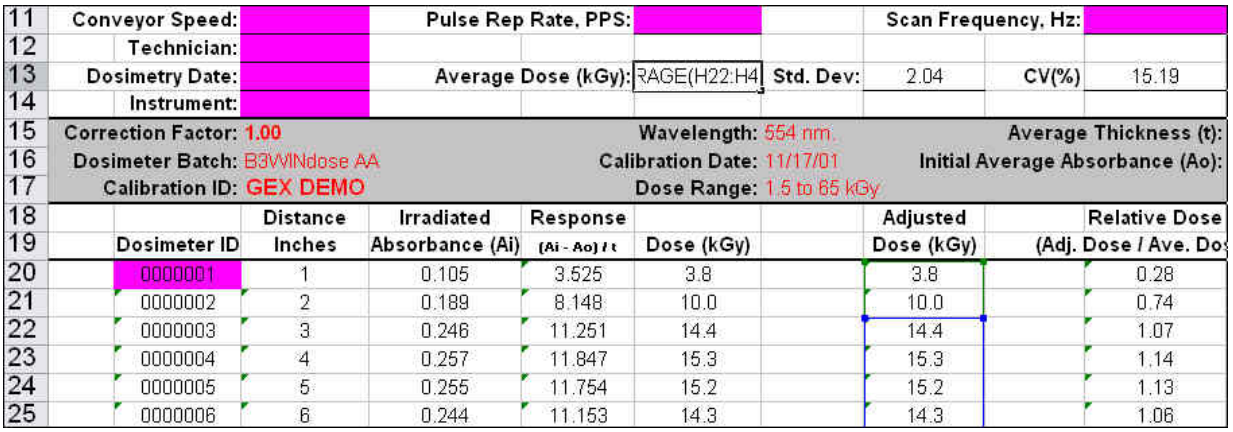


Note that the cell F13 is highlighted and its formula appears in the Formula Bar. Then click on the range and it turns color, noting that it is selected. Then if you scroll down, you will see the range highlighted with a border box like the example below.



Note in the example below, there are two boxes that you must resize for the desired range. In this case one is blue and one is green. Extend or shorten the boxes depending on the modification required to achieve the desired range.



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11	Conveyor Speed:			Pulse Rep Rate, PPS:				Scan Frequency, Hz:		
12	Technician:									
13	Dosimetry Date:			Average Dose (kGy):	=(H22:H49))	Std. Dev:	2.04	CV(%)	15.19	
14	Instrument:									
15	Correction Factor: 1.00					Wavelength: 554 nm			Average Thickness (t):	
16	Dosimeter Batch: B3WINdose AA					Calibration Date: 11/17/01			Initial Average Absorbance (Ao):	
17	Calibration ID: GEX DEMO					Dose Range: 1.5 to 65 kGy				
18			Distance	Irradiated	Response			Adjusted		Relative Dose
19		Dosimeter ID	Inches	Absorbance (Ai)	(Ai - Ao) / t	Dose (kGy)		Dose (kGy)		(Adj. Dose / Ave. Do
20		0000001	1	0.105	3.525	3.8		3.8		0.28
21		0000002	2	0.189	8.148	10.0		10.0		0.74
22		0000003	3	0.246	11.251	14.4		14.4		1.07
23		0000004	4	0.257	11.847	15.3		15.3		1.14
24		0000005	5	0.255	11.754	15.2		15.2		1.13
25		0000006	6	0.244	11.153	14.3		14.3		1.06

The range now begins at H22. Resize the bottom portion of the box in the same manner until you have the desired range.

Std. Dev formula cell H13
Perform the same actions as for the Average Dose formula. They should utilize the same range of dosimeters.

CV cell J13
The coefficient of variance is calculated by dividing the Standard Deviation (**Std. Dev**) by the **Average Dose.** It is then multiplied by 100 so it can be expressed as a percent. This formula needs no change as you have already modified the range for the two components that are used to calculate CV.

Typically, a CV demonstrating good uniformity is one that does not exceed the dosimeter calibration uncertainty.

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B3110 Appendix

GEX *WINdose for Excel* B3110 Energy Wedge Card Array

DESCRIPTION

The B3110 product and its associated *WINdose for Excel* worksheet were specifically designed for use with the Risø aluminum wedge to estimate energies based on an extrapolated range technique for electron beam accelerator systems with approximate energies of 2 – 20 MeV. The product uses an array of *B3WINdose* dosimeters spaced at specific depth intervals on a die-cut card with two alignment holes that fit snuggly over the posts on the Risø wedge.

The B3110 product is specifically designed for use with the Risø HDRL two piece aluminum wedge (12 cm wide by 14 cm long by 2.9 cm thick when assembled) with a nominal 16° angle.

When the dosimeter optical absorbances are read into the worksheet and the corresponding doses calculated, an energy can be estimated using certain equations given in ISO/ASTM 51649. The worksheet also contains a chart that updates automatically and plots the dose point values per thickness depth. A trendline is plotted for the trailing penetration slope to determine the intercept factor used to estimate the energy.

GENERAL INFORMATION

Users should have a working knowledge of basic Microsoft Excel™ functions and charts in order to use the worksheets and manipulate the charts effectively.

The template is not completely protected to allow user flexibility. Some cells are unlocked to allow a user to adjust the curve fit for use with various energy systems.

The range of data used for the energy calculations and graphical plotting are preset at GEX. These ranges may need to be modified by the user to achieve the desired result.

For information regarding using the Risø Wedge, refer to GEX procedure template #100-260.The GEX website always has the current revisions of GEX procedure templates.

Measuring the B3110 Wedge Card Array
Open the workbook and select the appropriate worksheet from the tabs at the bottom of the screen. Enter the processing information in the top section of the worksheet. This information should be entered so that beam parameters can be documented. A standard set of process parameters should be used to establish a baseline and used for subsequent energy tests thereafter. For guidance see ISO/ASTM 51649.

The dosimeters are provided in sequential order for user convenience. Enter the first dosimeter number into cell B20 and the worksheet will automatically fill in the remaining numbers.

Measure the irradiated absorbances of each dosimeter on the wedge card from top to bottom in sequential order, filling in the worksheet as described in the Basic Operation section of this manual. For this type of worksheet, new rows are not added as in the standard dosimetry worksheets.

It may not be necessary to measure all dosimeters on the card: the lower the energy, the less penetration and therefore fewer dosimeters receive a dose. Discontinue making measurements after obtaining two or three absorbance measurements that are near dosimeter background.

Estimating the Energy
The worksheet automatically calculates and plots the dose values against the thickness of the aluminum.

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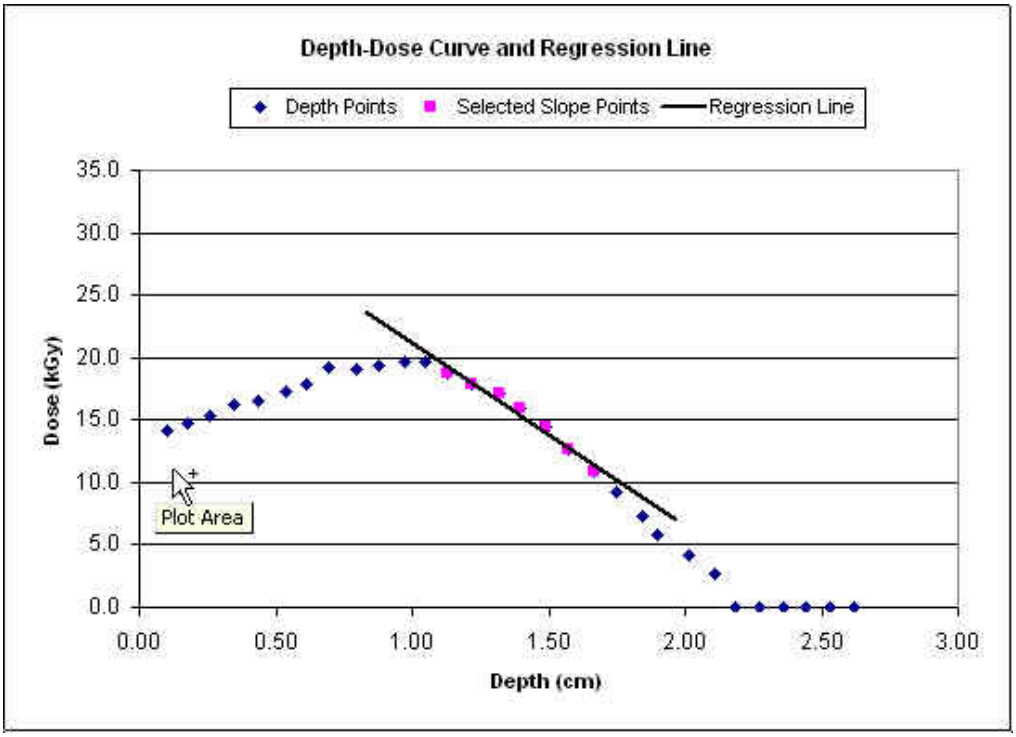
63					
64		Extrapolated Range (cm)			**NOTE:** The fitted series (Slope & Y intercept, and the
65		Slope	-18.82	Y-Intercept	42.22	Trend line on the chart) defaults to the 15th through
66						21st dosimeters only. The data ranges should be
67		R50	Rex			adjusted by the user to incorporate more or fewer
68		1.72	2.24			data points appropriate to the energy being tested.
69						See the *WINdose for Excel 2002* Installation and
70		Ea		Ep		Operations manual for detailed instructions.
71		10.56		11.506		
72						*Ea and Ep calculated using ISO/ASTM formulae*
73						*A3.19 and A3.18 respectively per ICRU Report 35*
74						

Adjusting the Energy Calculation and Graphical Representation:
The Extrapolated Range formulas, the Estimated Energy formula, and the Trendline on the chart are preset to ranges typical for 5 or 10 MeV. If needed, the user may define the quantity and location of points that are used to estimate the energy. Some experimentation may be necessary to determine the “ideal” fit.



Sample of a curve fit before selecting appropriate data range

In the example above, the points preformatted for the energy calculation are not the most preferred for the test. The points used will need to be modified along with the calculations of **slope** and **y-intercept**. It is usually easiest to begin with adjusting the trendline on the chart. The trendline on the chart is not linked to the other formulas. Adjusting this fit first guides the user in adjusting the calculations.

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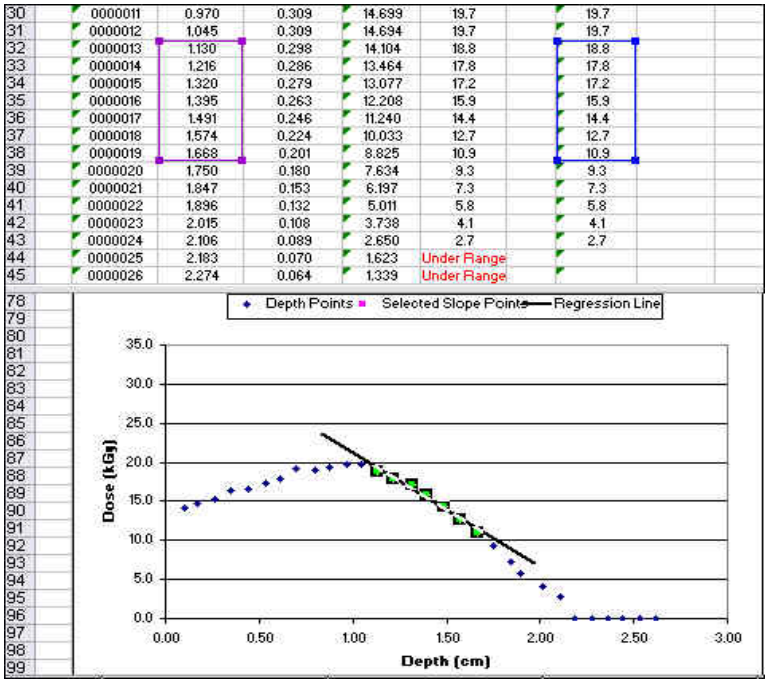
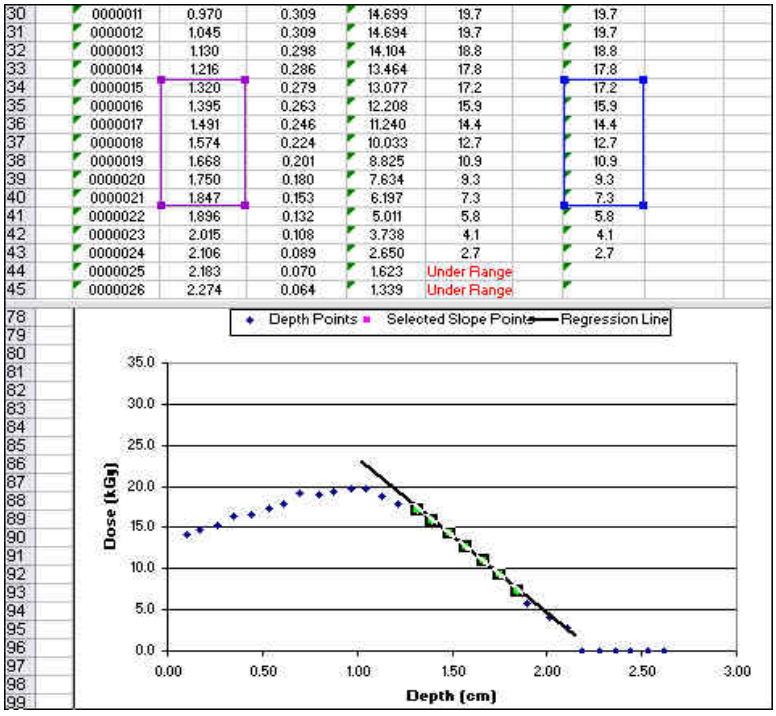
The steepest slope for the fitted portion of the depth-dose curve should be used for energy analysis. The blue spots represent all of the relative doses in the stacks. The magenta spots represent only the relative doses selected for the trendline curve fit. Click onto one of the magenta spots. The active data ranges for the trendline fit are highlighted. Select, drag or resize the range boxes to ranges that result in a slope that incorporates at least 5 depth and dose measurements.



Sample Trendline Editing



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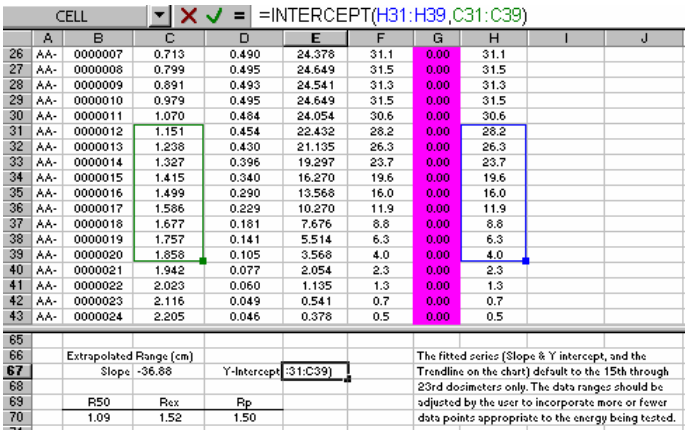
Select cell C65 (Slope formula). Click into the formula bar and edit the data range either manually or by dragging all the boxes to the same cells that were selected for the trendline.

Select cell E65 (Y-intercept formula). Click into the formula bar and edit the data range either manually or by dragging the boxes to the same cells that were selected for the trendline and slope in the graph.


CELL
=INTERCEPT(H31:H39,C31:C39)
Extrapolated Range (cm)
Slope -36.88
Y-Intercept :31:C39)
R50 Rex Rp
1.09 1.52 1.50
The fitted series (Slope & Y intercept, and the Trendline on the chart) default to the 15th through 23rd dosimeters only. The data ranges should be adjusted by the user to incorporate more or fewer data points appropriate to the energy being tested.

Example: Selecting Y-intercept data range

The extrapolated range parameters and estimated energy automatically re-calculate when the **slope** and **y-intercept** are modified.

Double check that the range used for the trendline on the graph match the ranges used in the **slope** and **y-intercept** calculations.

DISCUSSION:

The aluminum depth values used in the energy calculations were validated using a reference point for measurement based on the method described in ISO/ASTM 51649 Appendix A3. The use of other reference points may result in different energy estimations. Contact GEX for further technical discussion of this issue. Also refer to ISO/ASTM Note A3.10 for additional information.

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